Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Journal of Clinical Anesthesia 65 (2020) 109884

Contents lists available at ScienceDirect

Journal of Clinical Anesthesia

journal homepage: www.elsevier.com/locate/jclinane

Correspondence

Modified oxygen therapy device for prevention of aerosol dispersion in COVID-19 patients

Coronavirus disease 2019 (COVID-19) is a respiratory tract infection caused by a newly emergent coronavirus, which was first recognized in Wuhan, China, in December 2019. COVID-19 virus is primarily transmitted between people through respiratory droplets and contact routes. The risk of transmission of this infection to the healthcare workers (HCW) depends on several conditions; some of them are nonspecific such as prolonged exposure, inadequate hand hygiene and personal protective equipment (PPE), insufficient spacing, or rooms without negative pressure or insufficient air changes every hour [1]. A COVID dedicated area is prone to be contaminated with droplets generated by symptomatic patients and precautions should be taken to minimize expired air dispersion to the surrounding environment especially during oxygen therapy and aerosol-generating procedures. In oxygen therapy via nasal cannula: exhaled air spreads to 66 cm when the oxygen flow setting is 1 lit/min, to 70 cm when it is increased to 3 lit/min and 1 m when it is 3–5 lit/min [2]. In oxygen therapy via oronasal masks: the exhaled air jet reaches 40 cm with an oxygen flow of 4 lit/min [3]. In oxygen therapy via Venturi mask: exhaled air dispersion on delivering 24% oxygen with a flow rate at 4 lit/min in a normal lung and severe lung injury are 40 cm and 32 cm, respectively. When 40% oxygen is delivered at an 8 lit/min flow rate the exhaled air dispersion distance is, in the same two lung settings, 33 cm, and 29 cm, respectively [4]. In oxygen therapy via non-rebreathing mask: exhaled air dispersion distance is < 10 cm irrespective of oxygen flow rate (6–12 lit/min) in either normal lung or severe lung injury [5].

Here we modified a high flow non-rebreathing mask with an oxygen reservoir bag, which is easily available in a hospital setting [Fig. 1, Panel A]. Three valves present in this assembly were reversed to serve our purpose [Fig. 1, Panel B]. The facemask was inverted in such a manner that the unidirectional expiration valve comes inside and works as a unidirectional inspiration valve. The unidirectional inspiratory valve attached to the reservoir bag was reversed and connected using a 22 mm connector in such a manner it now works as a unidirectional expiration valve [Fig. 1, Panel C]. Oxygen from the oxygen feeding tube now directly comes inside the mask bypassing the oxygen reservoir bag. The oxygen reservoir bag acts as an expired air reservoir bag, from where expired air passes to central suction via a suction tube. This whole assembly acts as a closed system from which there are very fewer chances of exhaled air and aerosol dispersion to the surrounding during oxygen therapy. This device can also decrease the droplet dispersion during coughing and sneezing by the patient. Moreover, it can safely be used in situations where high flow oxygen therapy is required. The various advantages of this modified reverse valve high flow oxygen mask device are:

1. Prevent aerosol dispersion during oxygen therapy of COVID-19 patients.
2. Assembly can be easily made by modifying an easily available device.

The use of this device, however, needs titration of suction pressure during its use. This device is a prototype and a better design of facemask based on these principles can be engineered in the future.

https://doi.org/10.1016/j.jclinane.2020.109884
Received 6 May 2020; Accepted 17 May 2020
0952-8180/

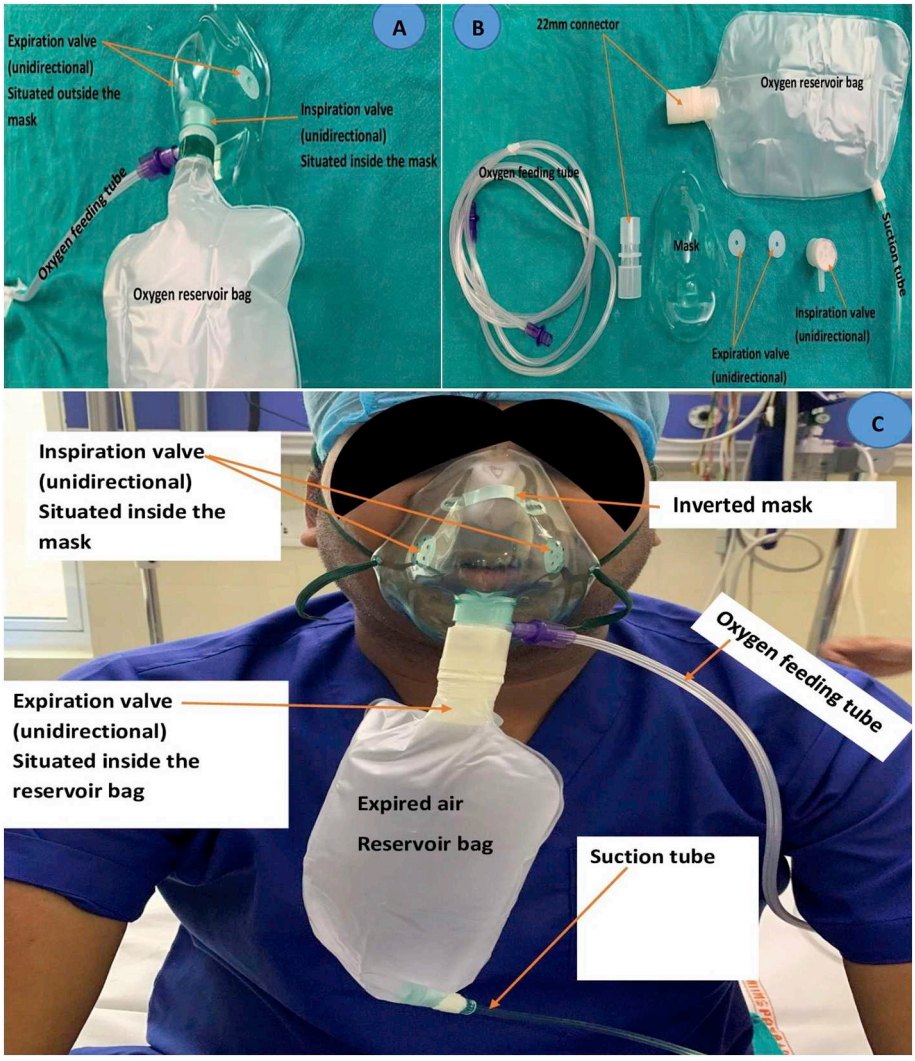

Fig. 1. [A] A high flow non-rebreathing face mask with reservoir bag, [B] components of the device assembly, [C] modified reverse valve high flow oxygen mask closed assembly.

Source of funding

Nil.

Consent

Taken from the patient.

Declaration of competing interest

Nil.

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